Chapter 3
Scoping the Investigation

3-1. General

A preliminary assessment should be made to gain an understanding of the key issues and concerns to be addressed in the analysis. This assessment leads to an initial hydrologic engineering management plan, based on the main considerations of the study.

3-2. Study Objective

The major study objectives should be defined; flood damage reduction, navigation, water supply, environmental restoration, water control, hydropower, etc. Geographic scope of the study should be determined and key locations requiring hydrologic information specified. Preliminary hydrologic engineering requirements and strategies to accomplish these objectives may be postulated.

3-3. Type of Study

The type of study requires different levels of hydrologic planning, ranging from very little to extensive. The various studies for which a HEMP may be developed are described in the following paragraphs, with reconnaissance, feasibility, and preconstruction engineering and design comprising the usual path for most Corps studies.

a. Reconnaissance-phase study.

(1) Initial HEMP. An initial HEMP should be prepared to provide a cost estimate for the reconnaissance phase, which is 100 percent Federally funded. However, reconnaissance funds are usually obtained in advance of hydrologic engineering planning, as this phase emphasizes the use of existing studies and data to perform the hydrologic analysis. For this situation, a HEMP may be prepared and used as an internal document. If time and funding permit, establishing the without-project hydrology and hydraulics for the existing condition of the watershed is desirable.

(2) IPMP. An IPMP is the end result of a successful reconnaissance-phase study, which must include adequate technical hydrologic engineering information to successfully complete a feasibility cost-sharing agreement (FCSA) with the sponsor. The hydrologic engineering management plan must identify the major technical activities and establish time and cost estimates. The estimates are used in the initial project management plan to develop funding and scheduling required for the feasibility-phase investigation. An initial HEMP would normally be prepared at the end of the reconnaissance phase. Any complex or unusual technical hydrologic issues should be discussed at the technical review conference (TRC) required at the end of reconnaissance and included in the plan. An example of an initial hydrologic engineering management plan for a local protection project is shown in Appendix C.

b. Feasibility-phase study.

(1) Detailed HEMP. As soon as feasibility funding is received, the initial HEMP of the reconnaissance phase may be expanded to detail the hydrologic engineering activities for week-to-week use by the hydrologic engineer throughout the study. Technical studies are detailed so that work activity durations may be established, milestone dates set, etc. Examples of detailed HEMP's are shown in Appendices D, E, and F. This phase results in a feasibility report with a series of engineering appendices. The appendices are in sufficient detail to allow the work effort to generally proceed directly to the design memorandum phase.

(2) Project management plan. A project management plan is prepared at the end of the feasibility-phase study, assuming an economically justified project is recommended and a cost-sharing partner exists. It requires sufficient hydrologic engineering detail to scope, cost, and schedule the activities for the balance of preconstruction engineering and design. The PMP forms the basis for the project cooperation agreement (PCA) with the sponsor, to complete the detailed design and construct the project. The major hydrologic engineering activities for PED must be identified and cost estimates made for the project management plan. Figure 1 illustrates this phase.

c. Preconstruction engineering and design. The PED phase concentrates on the detailed design of the project. It would normally be expected to consist of one or more design documents and plans and specifications to construct the project.

(1) Design memoranda. The project should move directly from the feasibility phase to PED, with a design memorandum (DM) to establish the detailed technical design necessary to construct the project. Consequently, a detailed HEMP would be prepared at the start of PED to outline the balance of the technical hydrologic engineering effort. This detailed HEMP would build on the initial hydrologic engineering management plan prepared for the PMP. PED hydrologic activities often include physical

model testing, detailed hydraulic design, quantitative sediment transport analysis, two-dimensional flow analyse, etc., which provide the technical detail for final design of the project.

(2) Plans and specifications. The detailed HEMP prepared at the start of PED should include the hydrologic activities necessary for this phase of the project. Hydrologic engineering effort in the plans and specifications phase typically incorporates results of physical model tests into the hydraulic design, preparation of stage hydrographs to show potential high-water periods affecting construction, minor modifications in the hydraulic design based on the additional detailed topographic and soils data obtained, and any changes found in the site conditions.

d. Continuing authority. These studies are typically performed as a two-phase process: a reconnaissance report performed at Federal expense, followed by a cost-shared detailed project report.

(1) Reconnaissance. The reconnaissance phase of a continuing authority study is similar to a feasibility investigation. It is performed at 100-percent Federal expense under the continuing authorities program. A HEMP is prepared for the reconnaissance phase after receipt of funding. The HEMP would be similar to that of paragraph 3-3*a* to establish funding requirements for the reconnaissance-phase study.

(2) Detailed project report. The detailed project report (DPR) is equivalent to a feature design memorandum; therefore, a hydrologic engineering management plan similar to that needed for the PMP would be prepared at the end of the reconnaissance report, with a detailed HEMP formulated after receipt of detailed project report funding. The hydrologic engineering management sequence for continuing authority studies is illustrated in Figure 2.

e. Regulatory. An assessment of the impact of a proposal is necessary to obtain a permit for project construction in the floodplain. The hydrologic information needed to submit the permit for Corps projects should be readily available from previous work. A hydrologic engineering management plan for regulatory purposes should seldom be necessary.

f. Water control. Establishing a water control plan for a new project or updating an existing plan for new or changed purposes represents a major hydrologic engineering effort. The plan is described in a water control manual. Funding is usually from the operation and maintenance (O&M) program for an existing project. General investigations funding (reconnaissance and feasibility) is appropriate for analyzing the addition of new project purposes to an existing project. A HEMP is necessary to establish time and cost estimates for O&M funding. A detailed hydrologic engineering management plan is prepared for technical activities after receipt of funding. Hydrologic engineering funding for water control activities for a new project should be included with the HEMP for the PED-phase work effort.

g. Water supply. These investigations normally concentrate on potential reservoir storage reallocation for

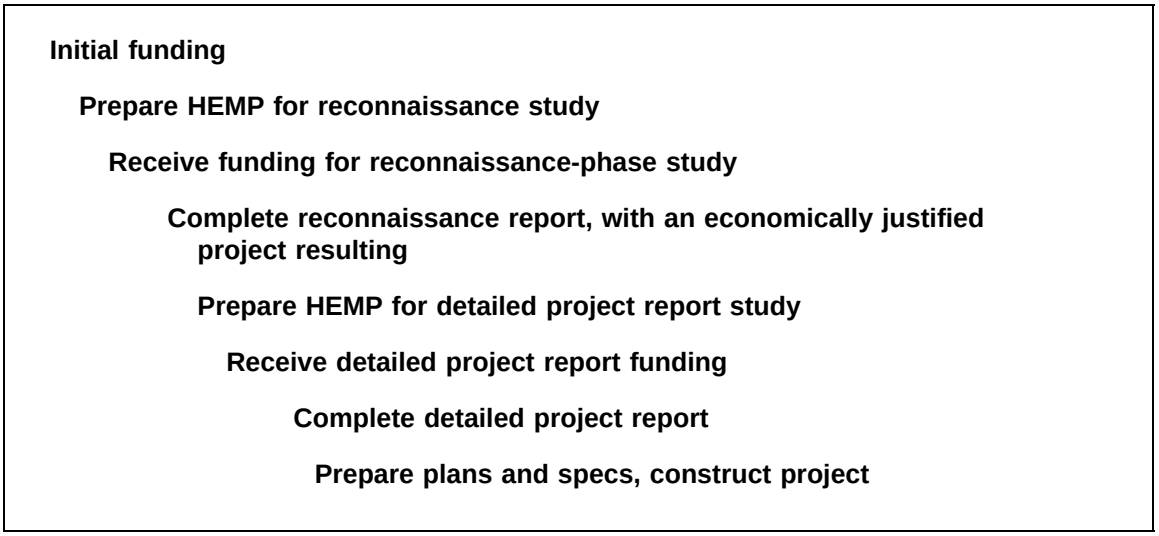

Figure 2. Sequence of hydrologic planning activities for continuing authority studies

water supply or for drought operation planning. A two-phase planning process (reconnaissance and feasibility) would be followed for reservoir reallocation studies, with the HEMP requirements similar to those described in paragraphs 2-3*a* and *b*. Drought operation planning is usually done for an existing project with O&M funding. A HEMP would be necessary for accurate estimates.

3-4. Key Items to Evaluate

a. Major issues. The HEMP must outline the information and methods necessary to address the major issues of the hydrologic engineering study. Methods and procedures needed to address complex or precedent-setting problems, sensitive environmental concerns, use of outside consultants (including Corps labs), local sponsor requirements, the need for new physical or analytical model development, adverse effects caused by a potential project, etc., would be scoped for budgeting purposes.

b. Level of detail. Although the study phase will usually establish the overall level of detail, the interdisciplinary planning team must be queried to obtain their ideas on the hydrologic information they need. However, the hydrologic engineering effort often plays the largest role in determining the level of detail. Depending on the appropriate study costs, several iterations between the hydrologic engineer and the study team may be necessary to establish a level of detail commensurate with the level of study funding. The development of a detailed plan, prepared at the start of the study, should result in a more efficient and effective progression of the study. Adequate planning at the start of the study may result in lower overall hydrologic engineering costs.

c. Hydrologic information availability and requirements. Databases would be examined to determine the rainfall, streamflow, topographic, and other records available for the particular study. The need for establishing a limited data collection program to address the objectives of the study would be determined. Existing Federal and non-Federal projects (reservoirs, levees, water withdrawals, etc.) affecting the analysis would be determined.

d. Unusual features.

(1) Items requiring additional engineering effort. Items peculiar to the study area that require additional hydrologic engineering effort must be addressed, especially if the work is necessary in the feasibility investigation.

(a) Flat slopes and wide floodplains could require a one- or two-dimensional unsteady flow analysis, resulting in significant higher study costs compared to using simpler models.

(b) Major quantitative sedimentation investigations may be necessary to firmly establish project feasibility. Reservoirs and extensive channel modifications may require significant quantitative sediment investigations during the feasibility phase.

(c) Physical model testing may be required during feasibility to ensure the workability of a project, such as locating a replacement lock away from the main navigation channel or designing a super-critical flow channel for a highly populated area.

(d) Lake stage-frequency analysis in closed basins, that do not drain to a downstream watershed.

(e) Major groundwater, snow hydrology, water quality, or other investigations.

(f) Complex reservoir system problems in which political or environmental issues mandate extensive and unusual systems modeling.

(g) Unstable rating relationships, complex interior flood control studies, multi-reservoir analyses, and other difficult water resource analyses must be recognized and evaluated during the early planning process leading to a HEMP.

(2) Peer review. Studies having unusual features and complex analyses may benefit from peer review. HQUSACE has established a peer review procedure through the HQUSACE-sponsored Hydrology Committee, with membership consisting of selected senior hydraulic engineers from Districts and Divisions. The Hydrology Committee will meet with District personnel to review the study/project and offer suggestions on the District's plan of analysis. The District incurs no cost for committee participation. Separate committees on Channel Stabilization, Tidal Hydraulics, and Water Quality are also available for assistance on unusual features in these areas. ER 15-2-14 further describes these four committees.

e. Study boundaries. The HEMP must distinguish between study boundaries and project boundaries in the development of estimates. Project effects often extend far upstream and downstream on the main stem of the study

stream, as well as up tributaries. Proposed projects may change the flood hydrology and sediment regime throughout the watershed, not just near the proposed project. Changes in water control management practices at Corps reservoirs can also affect interests remote from the reservoir site. The hydrologic analysis must include the evaluation of all positive and negative effects of a potential project or water control management change throughout the stream system or study area.

f. Likely alternatives. The screening process used in the reconnaissance phase should result in a reduced number of alternatives to evaluate in detail for determination of the national economic development (NED) plan during the feasibility phase. The HEMP will include the most practical alternative(s) or combinations of alternatives to estimate the cost of the hydrologic engineering work effort. The major with-project scenarios must be developed by the study team for both preliminary and final scoping of the technical activities. The no-action case must also be determined for comparison to the with-project alternatives. Similarly, agreement should be reached among study team members, during the HEMP preparation, concerning the number of iterations (or sizes) to be evaluated for each alternative. Three or four sizes for each of two or three alternatives should be adequate for most studies.

3-5. Major Hydrologic Engineering Activities Required

The Corps typically assesses with- and without-alternative conditions for the main study objective(s).

a. Flood damage reduction. The HEMP should describe or reference the major study components: watershed hydrology, river hydraulics, frequency analysis, sedimentation analysis, storage operation, hydraulic design, etc., for both the with and without alternative condition. Analysis will often involve discrete events, either actual or, more typically, hypothetical, and will include development of uncertainty relationships for risk-based analysis. ER 1105-2-100 contains additional information in this area.

b. Water control management. The HEMP should describe or reference the major study components: flood control capabilities, storage allocated for various project purposes, drought augmentation, operational analyses, data systems, forecasting, etc., for the existing and proposed method of regulation. Analyses usually involve discrete events and continuous record techniques. ER 1110-2-240 and EM 1110-2-3600 contain additional information in this area.

c. Water supply investigations. The HEMP should describe or reference the major study components: existing project purposes and storage allocations of each, upstream and downstream demands, supply analysis, hydraulic data (uniform database), drought frequency analysis (volumes and durations), distribution system (pumping, conveyance, and storage), etc., for the existing and proposed reallocation of reservoir storage. Analysis may be for one or more severe droughts, although the full period of record can be used, similar to water control management methods. ER 1110-2-241 and ER 1110-2-1941 contain additional information.

3-6. Primary Hydrologic Engineering Investigation Products

The hydrologic engineering results needed by the study team may include the following information, as discussed by general study type:

a. Flood damage reduction. The main product will be the damage reduction effects of the selected alternative on the floods in the watershed. Supplemental investigation products could include: discharge-frequency relationships, flood elevations, and areas inundated with and without a specified structural alternative (reservoir, channel, levee, diversion, pumping plant), stage-duration relationships, sizes of various alternatives for costing purposes, sedimentation analyses, residual flooding, flood forecasting and warning system, etc. Nonstructural alternatives may require only the without-project condition, since these alternatives affect the stage-damage relationship only and result in little, if any, change in hydrologic or hydraulic relationships.

b. Water control management. The main product will be a new or revised set of procedures for project operation and hydrologic forecasting, contained in a water control manual. A range of flows should be addressed, from the inflow design flood to the record drought. Effects on the watershed sediment regime could be a required product. Supplemental investigation products could include: operation procedures, stage-duration and frequency, discharge-frequency, emergency operation procedures, gage data network, computer equipment needed, conservation and/or hydropower procedures, flood warning and preparedness procedures, and other required information.

c. Water supply investigations. The main product will be a reservoir storage reallocation to satisfy changed demands, such as decreased hydropower storage for increased water supply storage, or to satisfy as many critical demands as possible during time of drought. Water supply studies are usually performed for storage reallocations of existing reservoirs or for drought contingency planning for existing Federal reservoirs. Drought contingency planning analysis is a separate study, but is usually included as an appendix to a reservoir water control manual. Supplemental investigation products could include both seasonal and annual: current and modified condition discharge-frequency, reservoir storage-frequency, pool elevation-duration, flow- or storage-duration relationships, and power generation values.